Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2013

Marking Scheme

Physics

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

General Guidelines

In considering this marking scheme the following points should be noted.

1. In many instances only key words are given, words that must appear in the correct context in the candidate's answer in order to merit the assigned marks.

2. Marks shown in brackets represent marks awarded for partial answers as indicated in the scheme.

3. Words, expressions or statements separated by a solidus, /, are alternatives which are equally acceptable.

4. Answers that are separated by a double solidus, //, are answers which are mutually exclusive. A partial answer from one side of the // may not be taken in conjunction with a partial answer from the other side.

5. The descriptions, methods and definitions in the scheme are **not** exhaustive and alternative valid answers are acceptable. Marks for a description may be obtained from a relevant diagram, depending on the context.

6. Where indicated, 1 mark is allocated for correct units.

7. Each time an arithmetical slip occurs in a calculation, one mark is deducted.

8. The context and the manner in which the question is asked and the number of marks assigned to the answer in the examination paper, determine the detail required in any question. Therefore, in any instance, it may vary from year to year.

Section A (120 marks)

Three questions to be answered.

Question 1 40 marks

You carried out an experiment to measure *g*, the acceleration due to gravity.

(i) Draw a labelled diagram of the apparatus you used. **6 + 2×3**

labelled diagram to show:

falling object; ball	// pendulum bob	//picket fence	6
timer; timer shown in diagram	//stop-watch	//photogate (and timer)	3
detail; stop/start mechanism	//fixed point/split cork	//calculator/computer	3

NOTE: no labels, deduct 1

all valid methods are acceptable e.g. data logging methods, which fit the scheme

(ii) State the measurements you took during the experiment. **2×3**

distance	// length (of pendulum)	// selected *v* versus *t*	*/s*	3
time	//period (of pendulum)	// slope of graph	*/t*	3

(iii) Describe how you took these measurements. **6 + 3**

1st correct instrument 6

2nd correct instrument 3

(iv) How did you calculate a value for *g* from your measurements? **3×3**

substitute (for *t* and *s*) into the relevant equation

$g = \frac{2s}{t^2} / s = \frac{1}{2}gt^2$ // $g = \frac{4\pi^2 l}{T^2} / T = 2\pi\sqrt{\frac{l}{g}}$ 3×3

one error in the equation e.g. $g = \frac{2s}{t}$ // $g = \frac{4\pi l}{T^2}$ □ (2×3)

partial answer e.g. substitute into the equation/draw a graph (of T^2 versus l) (3)

(v) Give one precaution that you took to get an accurate result. **4 or 2**

any valid specific precaution, which has not already been awarded marks

e.g. use the smallest time value recorded for *t* // swing through small angle 4

any valid general precaution e.g. repeat the experiment a number of times (2)

Question 2 40 marks

A student carried out an experiment to measure the specific latent heat of fusion of ice. The following is an extract from her report.

"I first set up the apparatus for this experiment. I prepared the ice. I added the ice which was at 0 °C to the warm water. I found the mass of the ice. When all the ice was melted I took a temperature reading. I was then able to calculate the specific latent heat of fusion of ice."

(i) Draw a labelled diagram of the apparatus used in the experiment. 4×3

labelled diagram to show:

calorimeter (with water)		3
thermometer	// temperature sensor	3
ice		3
other detail e.g. insulation/(electronic) balance/stirrer, etc.		3

incorrect experiment, maximum mark 3×3

NOTE: no labels, deduct 1

(ii) How did the student prepare the ice for the experiment? 6 or 3

crushed, dried, melting ice used	one correct	6
preparation may be inferred from the diagram		
partial answer e.g. in the fridge		(3)

(iii) How did the student know that the ice was at 0 °C? 3

stand in ice-water mixture / (use) melting (ice) 3

(iv) How did the student find the mass of the ice? 3×3

subtract	3
initial mass (of calorimeter and water)	3
from final mass (of calorimeter and water and melted ice)	3
partial answer e.g. using a weighing scales	(3)

(v) Why did the student use warm water in the experiment? 6 or 3

increase accuracy //ice melts faster // less heat loss // heat lost = heat gained	6
partial answer e.g. so that the ice would melt	(3)

(vi) What precaution did the student take when adding the ice to the water? 4 or 2

avoid splashing//did it quickly//ensured the ice was dry//added lots of ice//stir, etc.	4
partial answer e.g. wore gloves	(2)

Question 3 40 marks

An experiment to measure the refractive index of a substance was carried out by a student. When the apparatus had been set up the student made a series of measurements. The student repeated the experiment a number of times.

(i) Draw a labelled diagram of the apparatus that the student used in the experiment. **6 + 2×3**

labelled diagram to show:

glass/plastic block	// container of liquid	6
ray box / laser / optical pins	// optical pins	3
detail; protractor // mirror	// metre stick	3

other valid methods acceptable

incorrect experiment, maximum mark 6 + 3

NOTE: no labels, deduct 1

(ii) What measurements did the student take? **6 + 6**

angle of incidence / i	// real depth	6
angle of refraction / r	// apparent depth	6

critical angle (2 × 6)

partial answer e.g. angles / height (6)

measurements may be inferred from the diagram

(iii) How were these measurements used to calculate the refractive index of the substance? **10 or 7 or 4**

$(n =)\frac{\sin i}{\sin r}$ // $(n =)\frac{\text{real depth}}{\text{apparent depth}}$ // $(n =)\frac{1}{\sin c}$ 10

one error in equation e.g. $n = \sin i \times \sin r$ (7)

partial answer e.g. substitute into the equation (4)

(iv) Why did the student repeat the experiment? **6 or 3**

for increased accuracy / to get average / to draw a graph 6

partial answer (3)

Question 4 40 marks

In an experiment to investigate the variation of the resistance *R* of a thermistor with temperature *θ* a student measured the resistance of a thermistor at different temperatures.

(i) Draw a labelled diagram of the apparatus used in the experiment. **4×3**

labelled diagram to show:

thermistor (in waterbath)		3
thermometer	// temperature sensor	3
ohmmeter	// datalogger	3
detail e.g. heat source, used hot water, test tube containing glycerol, etc.		3

NOTE: no labels, deduct 1

(ii) How did the student measure the resistance of the thermistor? **6 or 3**

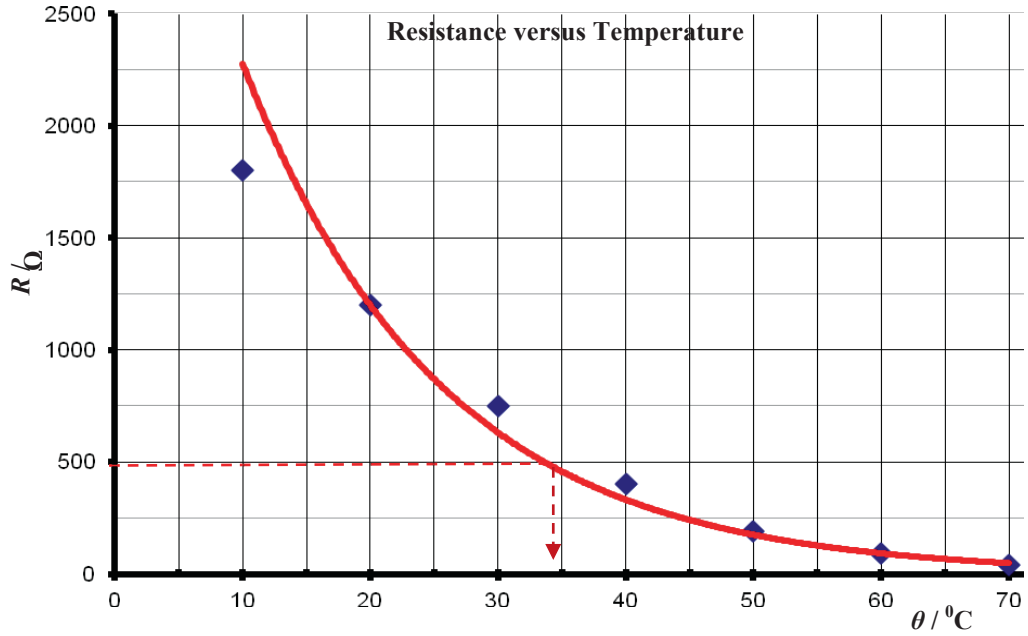
ohmmeter/(digital) multimeter (set to ohms)//measure *V* and *I* and hence determine *R* 6

partial answer e.g. meter (3)

The table shows the measurements recorded by the student.

θ/°C	10	20	30	40	50	60	70
R/Ω	1800	1200	750	400	190	90	40

(iii) Plot a graph on graph paper to show the relationship between resistance *R* of the thermistor and the temperature *θ*. (Put *θ* on the *X*-axis.) **4×3**



label axes correctly, (name / symbol / unit acceptable) 3

plot three points correctly 3

plot another three points correctly 3

(smooth) curve 3

if graph paper is not used, maximum mark 3 × 3

if *θ* is on the Y-axis, maximum mark 3 × 3

(iv) Use the graph to estimate the temperature of the thermistor when its resistance is 500 Ω **4 or 2**

34 °C to 37 °C // value consistent with the graph 4

partial answer e.g. evidence of using the graph (when *R* = 500 Ω) (2)

(v) What can you tell from the graph about the relationship between the resistance of a thermistor and its temperature? **6 or 3**

resistance goes down with increased temperature // non linear // not proportional 6

partial answer e.g. mention of proportional (3)

SECTION B (280 Marks)

Five questions to be answered

Question 5 any *eight* parts 56 marks

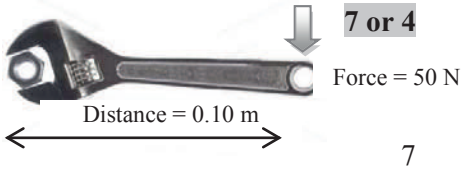
Take the best 8 from 10 parts

(*a*) Give an example of (i) a vector quantity, (ii) a scalar quantity. **7 or 4**

correct examples of each 4 + 3

partial answer e.g. examples in reverse order, definitions given (4)

(*b*) The spanner shown in the diagram is used to turn a nut. Calculate the moment of the force applied by the spanner to the nut. **7 or 4**



5 (N m) 7

partial answer e.g. $F \times d$ // 50 ÷ 0.1 (4)

***(c)* Which of the following scientists is associated with the discovery of the structure of the atom?**

Einstein Rutherford Faraday Coulomb ? **7**

Rutherford 7

(*d*) What is meant by the threshold of hearing? **7 or 4**

minimum sound (intensity) audible // quietest sound that can be heard 7

partial answer (4)

(*e*) How does light travel through an optical fibre? **7 or 4**

(by) total internal reflection stated or shown by diagram 7

partial answer e.g. by reflection (4)

(*f*) Give a common use for a convex lens. **7 or 4**

magnification, (eye) glasses, binoculars, contact lenses, camera, etc. 7

partial answer e.g. use of convex mirror (4)

(*g*) What colour is the wire that is connected to the fuse in a standard three-pin plug? **7 or 4**

brown (red-brown) 7

partial answer e.g. blue, green-yellow (4)

(*h*) Give a common use for a capacitor. **7 or 4**

store charge / conducts a.c. /(radio) tuning / filtering / smoothing / timing / store energy / flash camera / phone charger, etc. 7

partial answer e.g. radio (4)

(*i*) What is the photoelectric effect? **7 or 4**

emission of electrons when light (radiation) is incident 7

partial answer e.g. emission of electrons (4)

(*j*) Name one method for detecting radioactive particles. **7 or 4**

Geiger-Muller tube, Geiger counter, solid state detector, cloud chamber, bubble chamber, GLE, photographic film, radioactive sensor, etc. 7

partial answer e.g. (radiation/film) badge (4)

Question 6 56 marks

Define (*a*) momentum, (*b*) force **2(6 or 3)**

(*a*) mass (multiplied by) velocity // mv 6

partial answer e.g. m, v (3)

(*b*) mass (multiplied by) acceleration // ma // causes acceleration 6

partial answer e.g. m, a (3)

State the principle of conservation of momentum **2×3**

(total) momentum before (interaction) // $m_1u_1 + m_2u_2$ 3

equal to (total) momentum after (interaction) // $= m_1v_1 + m_2v_2$ 3

partial answer e.g. incomplete equation (3)

Explain how the principle of conservation of momentum applies in the case of a jet engine moving an aircraft. **2×3**

(backward) momentum of air equal to 3

(forward) momentum of aircraft 3

marks may be obtained from a diagram

partial answer e.g. incomplete answer (3)

A truck of mass 5000 kg is moving with a velocity 10 m s^{-1} when it collides with a stationary car with a mass of 1000 kg. The truck and the car then move off together.

(i) Calculate the momentum of the truck and the car before the collision **6 or 3**

50 000 (kg m s^{-1}) 6

partial answer e.g. incomplete answer / mv (3)

(ii) What is the momentum of the combined vehicles after the collision? **4 or 2**

50 000 (kg m s^{-1}) / 6000v // the same as the momentum before collision 4

answer consistent with (i) above (4)

partial answer e.g. incomplete answer (2)

(iii) Calculate the velocity of the combined vehicles after the collision. **6 or 3**

($\frac{50000}{6000}$ =) 8.3 (m s^{-1}) 6

answer consistent with (ii) (6)

partial answer (3)

(iv) What is the momentum of the truck after the collision? **4 or 2**

(8.3 × 5000 =) 41 500 (kg m s^{-1}) 4

answer consistent with (iii) (4)

partial answer (2)

(v) If the collision between the truck and the car takes 0.3 seconds, calculate the force exerted by the truck on the car. **6 or 3**

($F = \frac{50000-41500}{0.3}$ // $\frac{8300}{0.3}$ =) 27.8 ± 0.2 (kN) 6

partial answer e.g. correct equation (3)

(vi) When the truck hits the back of the car the driver's airbag inflates. The airbag deflates when it is hit by the driver's head. Explain why the airbag reduces the risk of injury to the driver.? **6 or 3**

any relevant answer e.g. longer time reduced force on driver's head 6

partial answer e. g. refers to force, (3)

Question 7 56 marks

(a) What is meant by the frequency of a wave? **6 or 3**

number of waves per second 6

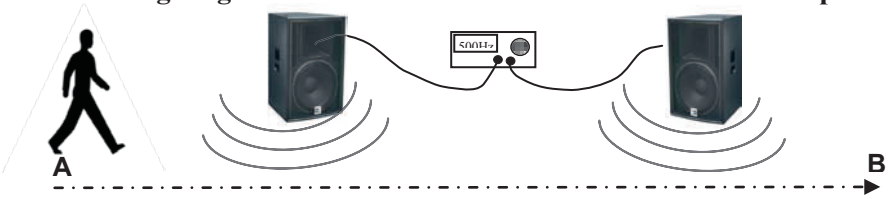
partial answer e.g. number of waves (3)

Give the relationship between the frequency and the wavelength of a wave. **6 or 3**

$c = f\lambda$ // f and λ inversely proportional 6

partial answer e.g. $f\lambda$ (3)

The diagram shows a student walking in front of two loudspeakers along the path between A and B. A signal generator set at 500 Hz is connected to the loudspeakers.



(i) What will the student notice as he moves from A to B? **6 or 3**

loudness varies // increasing and decreasing sound 6

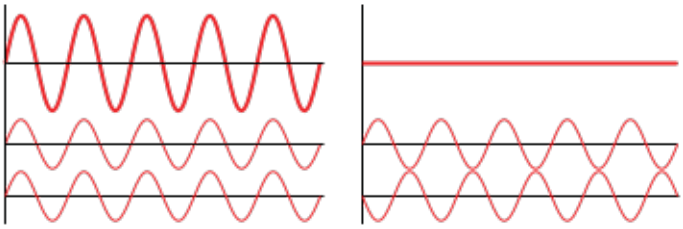
partial answer e.g. frequency varies (3)

(ii) Name this phenomenon **4 or 2**

Interference 4

partial answer (2)

(iii) Explain with the aid of a diagram how this phenomenon occurs. **6 + 3**



full marks may be obtained from a diagram 6 + 3

correct explanation alone e.g. two waves (crests/troughs/curves) meet and add (6)

partial answer e.g. example of interference (3)

(iv) Why should this phenomenon be taken into account in the placing of speakers in theatres or auditoriums? **6 or 3**

to ensure that all areas have equal loudness 6

partial answer (3)

(b) The note produced by a guitar string depends on the <u>fundamental frequency</u> of the string. The quality of the note depends on the number of <u>overtones</u> produced. The loudness of a note is increased by resonance in the body of a guitar.

(i) Explain the underlined terms **6 + 3**

fundamental frequency is the lowest / main frequency of an object

overtones are multiples of fundamental // higher frequencies produced // harmonics

two terms correct 6 + 3

one term correct (6)

partial answer (3)

(ii) How can the note produced by a guitar string be changed? **4 or 2**

change tension / (effective) length / amplitude 4

partial answer (2)

(iii) What is resonance? **2×3**

transfer of energy 3

between two objects of similar natural frequency 3

partial answer (3)

Question 8 56 marks

(a) An electric current is the flow of charge in a conductor when there is a potential difference between its ends.

(i) Name the unit of current **6 or 3**

amp / A 6

partial answer (3)

(ii) Give an example of a conductor **3**

any correct example e.g. named metal 3

(iii) Name a source of potential difference. **6 or 3**

cell / battery / power supply, etc. 6

partial answer (3)

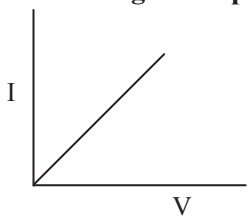
(iv) What are the charge carriers in semiconductors? **8 or 6 or 4**

electrons, holes two correct 8

one correct (6)

partial answer e.g. refers to doping /intrinsic/extrinsic/P type/ N type, etc (4)

(v) What type of conductor does the I-V graph in the diagram represent? **6 or 3**



ohmic / metallic / wire 6

partial answer (3)

(b) A magnetic field exists about a current-carrying conductor

(i) What is a magnetic field?. **2×3**

region / area /space 3

where iron is attracted / magnetic effect is felt 3

partial answer e.g. reference to force (3)

(ii) Describe an experiment to show that a long straight wire carrying a current has a magnetic field. Sketch the magnetic field. **5×3**

apparatus; source of current / battery / power supply 3

(plotting) compass // iron filings 3

procedure; complete the circuit / turn on the current 3

observation/conclusion: compass direction changes / iron filings rearrange 3

sketch the circular field (with correct direction) 3

accept valid alternatives

full marks may be merited by a labelled diagram

partial answer e.g. incomplete description (3)

(iii) Give an application of the magnetic field due to a current **6 or 3**

electromagnet, speaker, motor, induction coil, transformer, etc 6

partial answer e.g. an appliance containing a motor, etc. (3)

Question 9 56 marks

When heat is transferred to or from an object the temperature of the object changes.

(i) What is heat? **6 or 3**

(a form of) energy / $mc\Delta\theta$ /ml 6

partial answer e.g. J (3)

(ii) Name the three ways in which heat can be transferred. **3×3**

conduction 3

convection 3

radiation 3

partial answer e.g. (3)

(iii) Describe an experiment to show how heat is transferred in a liquid **3×3**

apparatus; liquid in glass beaker, heat source, (solid) dye any two 3

procedure; put the dye in the liquid and heat 3

observation/conclusion; the dye can be seen rising to the top of the liquid / convection currents visible 3

full marks may be obtained from diagrams

accept valid alternatives

partial answer e.g. incomplete description (3)

incorrect experiment maximum mark 2 × 3

The water in an electric kettle is heated by the element and its handle is made from an insulating material

(iv) How does the method of heat transfer in a liquid affect the positioning of the heating element in a kettle? **6 or 3**

heating element at the bottom of the kettle 6

partial answer e.g. incomplete answer (3)

(v) Why is the handle of a kettle made of an insulating material? **4 or 2**

insulator doesn't conduct heat // safe to touch 4

partial answer e.g. incomplete answer (2)

(vi) Name an insulator suitable for use in the handle of a kettle. **4 or 2**

any suitable insulator e.g. plastic, wood, ceramic, etc. 4

partial answer e.g. incomplete answer (2)

A kettle contains 1.3 kg of water with a specific heat capacity of 4200 J $kg^{-1}K^{-1}$. The temperature of the water rises from 10 °C to 80 °C during a three-minute period. Calculate

(vii) the energy gained by the water **3×3**

($E = mc\Delta\theta$ = (1.3)(4200)(80-10) =) 3.8×10^5 (J) 3×3

at least two quantities substituted correctly into the equation (2×3)

partial answer e.g. $mc\Delta\theta$ (3)

(viii) the power rating of the kettle, assuming all of the electrical energy is used to heat the water. **3×3**

P = 2123.3 (W) // answer consistent with (vii) 3×3

$3.8 \times 10^5 = P(180)$ (2×3)

partial answer e.g. $E = Pt$ (3)

Question 10 56 marks

X-rays are used to diagnose and treat medical conditions. The image shows an X-ray photograph.

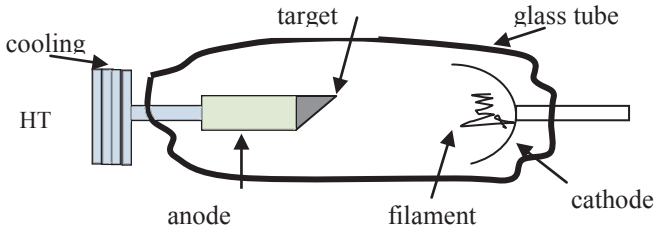
(i) What are X-rays? **2×3**
electromagnetic radiation // photons 3
high energy/frequency (low wavelength) 3
partial answer e.g. (3)

(ii) State a property of X-rays that makes them suitable for medical use. **6 or 3**
highly penetrating // selective absorbance 6
partial answer e.g. use such as to see broken bones // unsuitable property (3)

(iii) Give a use, other than medical, for X-rays **6 or 3**
airport security, X-ray telescopes/astronomy, weld/art inspection, thickness of metal, etc 6
partial answer e.g. general use such as industry/ agriculture (3)

In an X-ray tube a beam of electrons is used to produce X-rays

(iv) Draw a labelled diagram showing the main parts of an X-ray tube **4×3**



heater, cathode, anode, target, high voltage any three 3×3
detail e.g. correct arrangement / coolant / shielding/vacuum/extra item from previous line 3
partial answer (3)
Note: no labels, deduct 1

(v) How are electrons produced in an X-ray tube? **2×3**
heating // thermionic 3
metal // emission 3
partial answer e.g. by the cathode, using current, etc. (3)

(vi) What is the purpose of the high voltage in an X-ray tube? **6 or 3**
accelerate electrons // give energy to electrons // give enough energy to produce X-rays 6
partial answer (3)

(vii) What happens when the electrons hit the target in an X-ray tube? **6 or 3**
X-rays produced // target heats 6
partial answer (3)

(viii) Name a suitable material for use as the target. **4 or 2**
tungsten 4
partial answer e.g. (any named) metal (2)

(ix) Give one safety precaution required when using X-rays **4 or 2**
use a lead shield, protective clothing, lead glass, monitor dosage, reduce dosage, etc. 4
partial answer (2)

Question 11 56 marks

Read this passage and answer the questions below.

The National Grid - Ireland's Transmission System

The national grid system supplies electricity to customers. The grid consists of a network of high voltage transmission stations, power lines and cables delivering power to over 100 sub-stations all over Ireland. From these sub-stations power can be taken onwards on lower voltage lines to individual customers' premises.

The network includes approximately 6,000 km of overhead lines and underground cables. High voltages are used to avoid power losses which would otherwise occur when transferring power over long distances.

The control room of Ireland's national grid

Power is generated by power plants throughout the country, utilising a variety of fuel or energy sources, including gas, oil, coal, peat, hydro-electricity, wind turbines and other sources such as biomass and landfill gas. All of the major power plants feed into the national grid.

At the sub-stations power is transferred from the grid, transformed into medium and low voltage electricity and is delivered to Ireland's 2.1 million domestic, commercial and industrial customers.

(Adapted from ***EIRGRID*** *AT A GLANCE*, Eirgrid information publication.)

(*a*) What are the key components of the national grid? **7 or 4**

(network of high voltage) transmission stations and (high voltage) power lines 7

partial answer e.g. cables, low voltage lines, transformers (4)

(*b*) Why are high voltages used to transmit power over the national grid? **7 or 4**

to avoid power/energy losses // cheaper 7

partial answer e.g. (4)

(*c*) Why is the power supplied to domestic customers at lower voltages? **7 or 4**

safety // more suitable for home uses 7

partial answer e.g. (4)

(*d*) Name two renewable and two non-renewable energy sources used to generate electricity **7 or 4**

renewable: wind, solar, wave, hydroelectric, biomass, geothermal etc.

non-renewable: coal, oil, peat, gas, nuclear etc 7

partial answer e.g. incomplete answer (4)

(*e*) The national grid uses alternating current (a.c.) rather than direct current (d.c.). What is the difference between them? **7 or 4**

a.c. changes direction // d.c. flows in one direction // direction // frequency 7

partial answer e.g. come from different (power) supplies (4)

(*f*) Name the device used to convert high voltages to lower voltages? **7 or 4**

(step down) transformer 7

partial answer e.g. voltage converter, rectifier (4)

(*g*) Give the principle of operation of the device named in part (*f*). **7 or 4**

electromagnetic induction // answer consistent with named device in (*f*) 7

partial answer e.g. refers the use of the device or the magnetic field (4)

(*h*) Name the unit of electrical energy that is used in the delivery of electricity to homes and businesses. **7 or 4**

kilowatt-hour / kWh 7

partial answer e.g. J (4)

Question 12 56 marks

Part (a) Define pressure. **6 or 3**

pressure is the force per unit area // $P = \frac{F}{A}$ 6

partial answer e.g. incomplete equation, refers to force, etc. (3)

Describe an experiment to show that the atmosphere exerts pressure. **3×3)**

apparatus: can (containing water)	// can (of air)	// glass of water	3
procedure: boil water in can	// pump	// cardboard / lid	
seal / invert in cold water	// air out	// invert	3
observation/conclusion: can crushes / collapses		// lid supported	3

labelled diagram may merit marks
accept valid alternatives

partial answer (3)

A diver swims upwards from a depth of 50 m to a depth of 20 m below the surface of the water.

Calculate the decrease in pressure on the diver as she swims upwards. **13 or 9 or 4**

decrease in pressure due to water**:** = $4.9 \times 10^5 - 1.96 \times 10^5 = 2.94 \times 10^5$ (Pa) 13

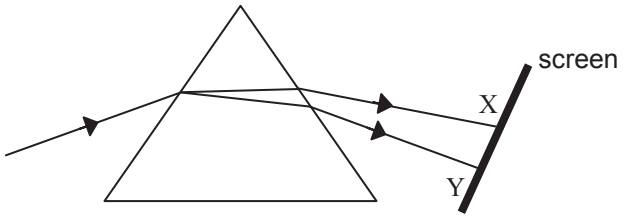
pressure due to water at 50 m**:** ($p = \rho gh = (10^3)(9.8)(50) =$) 4.9×10^5 (Pa)

pressure due to water at 20 m**:** ($p = \rho gh = (10^3)(9.8)(20) =$) 1.96×10^5 (Pa)

$(10^3)(9.8)(50) / (10^3)(9.8)(20)$ (9)

partial answer e.g. $P = h\rho g$ (4)

Part (b) The diagram shows a beam of white light undergoing refraction and dispersion as it passes through a prism.



(i) What is meant by dispersion? **2×3**

splitting/separating of light 3

into colours/frequencies/wavelengths 3

partial answer e.g. refers to different speeds of light / refractive indices (3)

(ii) What is observed on the screen between X and Y? **6 or 3**

spectrum // different colours 6

partial answer e.g. names two colours (3)

(iii) What information does dispersion give about the nature of white light? **4 or 2**

it consists of different colours // that it is a wave 4

partial answer e.g. (2)

(iv) Give another method for the dispersion of light **6 or 3**

(shine light through a) diffraction grating // (reflection from a) CD/DVD/oil 6

partial answer (3)

(v) Give an everyday example of the dispersion of light **6 or 3**

rainbow, reflection of light from a CD/DVD/oil 6

partial answer (3)

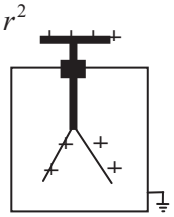
Part (c) State Coulomb's law of force between electric charges **2×3**

force proportional to product of charges // $F \propto Q_1 Q_2$ 3

inversely proportional to square of distance between them // $\propto \frac{1}{r^2}$ 3

partial answer (3)

The diagram shows a positively-charged electroscope.



(i) Give a use for an electroscope. **6 or 3**

detecting (measuring) charge / potential difference / capacitance 6

partial answer e.g. measures electricity (3)

(ii) How can an electroscope be given a positive charge? **2×3**

contact with // brought close to negative charge 3

positive conductor // and earthed 3

partial answer (3)

(iii) What is observed if you touch the cap of the electroscope with your finger? **4 or 2**

leaves collapse 4

partial answer (2)

(iv) Explain why this happens. **6 or 3**

(negative) charge flows from earth // earthing 6

partial answer e.g. refers to charge (3)

Part (d) Nuclear fission occurs in the reactor of a nuclear power station like the one shown in the photograph.

(i) What is nuclear fission? **2×3**

splitting (of large) nucleus 3

into (two) smaller nuclei // with release of energy/radiation // release of neutrons 3

partial answer e.g. definition of fusion (3)

(ii) Name a fuel used in a nuclear reactor **6 or 3**

plutonium / P, (enriched) uranium / U one correct 6

partial answer e.g. named reactor part such as boron steel, graphite (3)

(iii) How can the reaction in a nuclear reactor be controlled? **6 or 3**

correct reference to (control/boron) rods // refers to absorbing neutrons // vary (U) fuel 6

partial answer e.g. coolant (3)

(iv) How is the energy produced in a reactor used to generate electricity? **6 or 3**

heat exchanger // produces steam // turbine 6

partial answer e.g. generator (3)

(v) State a hazard of nuclear reactors. **4 or 2**

pollution /risk of nuclear contamination / fallout / difficulty of dealing with waste / health risk, dangerous, etc 4

partial answer e.g. war (2)

Blank Page

Blank Page

Blank Page